

INFLOW OF SAND CAUSED BY THE 1703 GENROKU KANTO TSUNAMI AS DESCRIBED IN HISTORICAL DOCUMENTS

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Abstract This paper investigates the inflow of sand into farmlands and the number of houses washed away in villages by the 1703 Genroku Kanto earthquake tsunami on the basis of historical documents. Some of these historical documents provide details about the inflow of sand such as the total area inundated and the subsequent recovery process. The records show that there were many areas damaged by the inflow of sand into farmlands as well as houses that were washed away. These areas correlate well with the distribution of stone monuments for the 1703 Genroku Kanto earthquake. Careful investigation of historical documents would provide useful information in tsunami deposit field surveys.

Key words: 1703 Genroku Kanto tsunami, historical tsunami, tsunami deposits, historical documents

1. Introduction

The 1703 Genroku Kanto earthquake (M7.9–8.2) occurred on December 31st, 1703 and caused severe damage including >10,000 fatalities and >28,000 collapsed or washed-away houses in the Kanto region (Usami *et al.* 2013). This earthquake was a great inter-plate earthquake between the continental plate and the Philippine-Sea plate and penultimate to the Kanto earthquake in 1923 (M7.9). The 1703 Genroku earthquake tsunami along the eastern coast of the Boso Peninsula in Chiba Prefecture has been investigated by the use of *kakocho*, family death registries, as well as stone monuments erected in memory of the tsunami victims (Hatori 1975a, b, 1976; Koyama 1982, 1983, 1987; Tsuji 2003).

The numbers of fatalities, washed-away houses, and tsunami heights in each village have been estimated in previous studies. However, areas presumed to have been inundated by the inflow of sand caused by the 1703 Genroku tsunami have not been investigated on the basis of historical documents. In this study, I collected historical documents related to salt farms and other official documents as well as historical documents that recorded damage resulting from the earthquake and subsequent tsunami.

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2. Date and Methods

I investigated areas inundated by the 1703 Genroku tsunami on the basis of historical documents. For example, the degree of damage is described in detail in "*Rakushido-nenroku*" by Yoshiyasu Yanagisawa. Tsunami inundated areas are mapped in this current paper according to present-day towns. Because the names of towns are different from those at the time of the disaster, I verified the location of each village by using maps drawn in the Meiji era. I also compared the inundated areas with the distributions of stone monuments as compiled by Satake *et al.* (2008).

3. Results and Discussion

Damage caused by tsunami

The tsunami heights along the Kujukuri coast (Kujukurihama), the eastern coast of the Boso Peninsula, were estimated at 5 m by Hatori (1976). Tsunami memorial monuments and "Muen-zuka", a tomb of someone with no relatives are still standing in Kujukurihama in Chiba Prefecture and along the coast of the southern part of the Boso Peninsula, showing that there was severe damage caused by tsunami (Satake *et al.* 2008). The number of washed-away houses in different villages was recorded in "*Rakushido-nenroku*" (Fig. 1). Severe damage due to tsunami was reported in villages along the Kujukurihama; for example, according to the History Compilation Committee of Kamogawa City (1996), >1,000 houses were washed away and >1,300 people were killed by massive tsunami in Maebara, Kamogawa City.

Inflow of sand caused by tsunami

Severe tsunami damage was reported in the villages along the Kujukurihama. The damage caused by the tsunami was not limited to human casualties but included the inflow of sand into farmlands (Fig. 1). Large tracts of farmland suffered from inflows of sand, which hindered the proper growth of crops. For example, in Ichinomiya Town, it took a long time for agriculture to recover due to the inflow of sand into rice paddies and farmlands (Ichinomiya Town 1964).

Farmers needed the support of the local governor to restore their rice paddies and farmlands. A petition to the local governor asking for tax relief stated that 166 houses had been washed away, around 34 *cho* (1 *cho* = 1 hectare) of rice paddies had suffered inflows of sand, 13 *cho* of farmland had sustained inflows of sand, and that 21 *cho* of land had suffered water rot. While rice paddies recovered within five years in Torami Village, it took 15 years for them to recover in other areas. In Araoi Village, ~7 *cho* of rice paddies and ~5 *cho* of farmland lost their arable capabilities due to the sand deposits.

In the "Diary of Kagetoshi Ino" chronicling events in Choshi-Kashima, the author wrote that he had heard that a tsunami had caused severe damage along the outer coast of the Boso Peninsula, and that many people were killed and horses were injured due to the tsunami at Iioka. Furthermore, the diarist recorded that boundaries of farmlands disappeared due to the deposited sand. However, the tsunami did not inundate along the coastal area from Choshi to Kashima-Ura.

According to the "Otaki Jyo Kaiki Kibun" (Usami ed. 2015), in the Isumi City region of the area in the south of Kujukurihama, farmers were unable to use their farmlands for a while due to the inflow of sand. "In the middle of the night (around 2:00 a.m.) on December 31st, 1703, a large

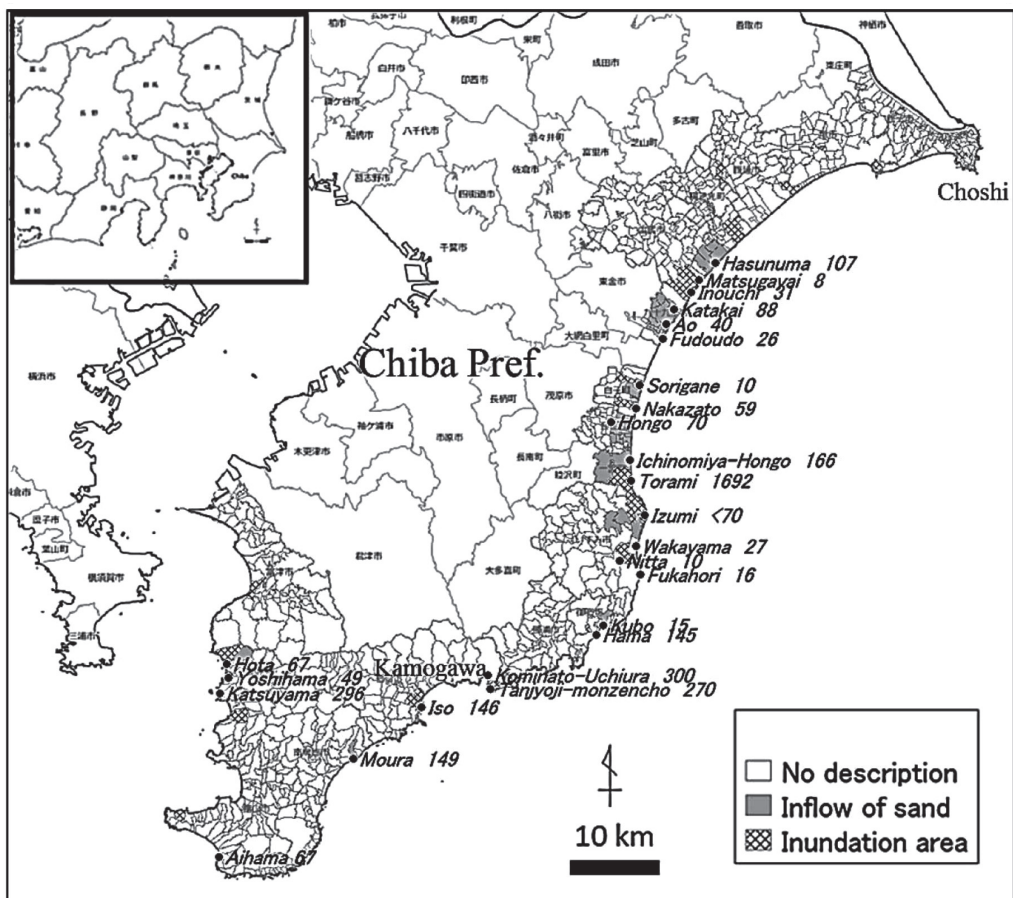


Fig. 1 Map showing areas that suffered sand inflows and the number of houses washed away in villages and farmland areas due to the 1703 Genroku Kanto tsunami. The information about the inflow of sand, the number of washed-away houses, and the inflow of tsunami was gathered from "Rakushido-nenroku" and other historical documents. The map shows locations according to the present administrative district.

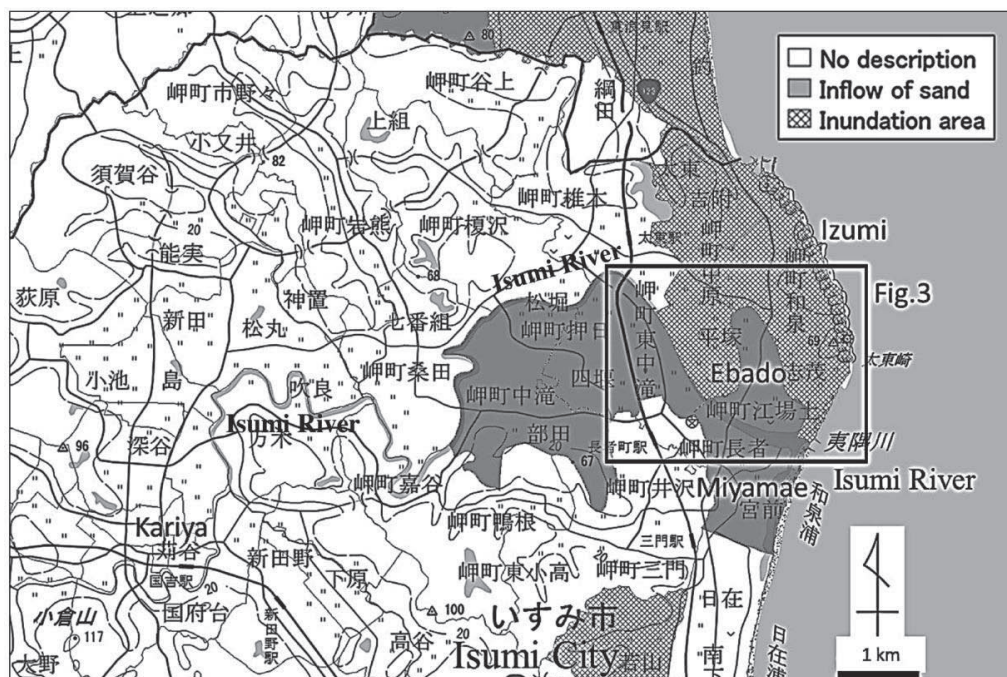


Fig. 2 Tsunami damage in the Isumi City region caused by the 1703 Genroku earthquake.

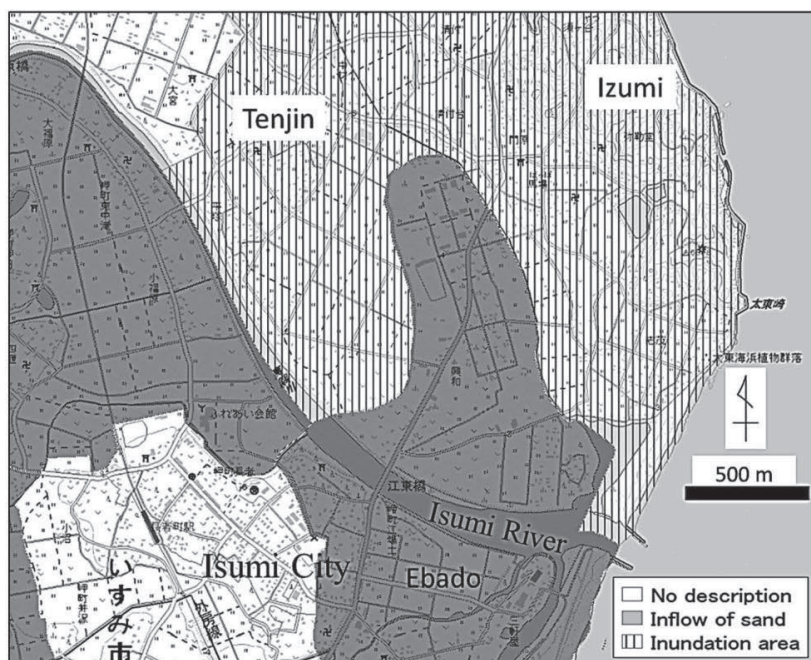


Fig. 3 Tsunami damage in Tenjin, Isumi City region, caused by the 1703 Genroku earthquake.

earthquake occurred and a tsunami with a height of ~4.5 m struck the Izumi district from the southeast (Fig. 2). About one third of Miyamae Village was inundated. Tsunami also inundated into the main street of Ebado, and reached the Kariya district through the Isumi River. In Usui Village, a large volume of sand was deposited up to near Cho-Onji Temple with a depth of 2–3 *shaku* (1 *shaku* = ~0.30 m) in rice paddies, and 1–2 *shaku* in farmlands.” According to litigation documents filed by Hyozaemon (Tenjin district), “In Izumi Village, <70 houses were swept away by the tsunami. My three fishing boats were also swept away. I found my three fishing boats in the Tenjin district. Two were severely damaged and one was completely destroyed by the tsunami. At a later date, I went to that district (see Fig. 3) to salvage my boats, only to find that some of them had been taken away or destroyed. Please punish the persons who destroyed my fishing boats.”

It became clear that a wide area had suffered damage from the inflow of sand in addition to houses that had collapsed or been washed away.

4. Conclusions

I found that a wide stretch of farmland suffered an influx of sand resulting from the 1703 Genroku Kanto earthquake tsunami and that crops did not grow well for several years as a result. Such information may be useful in contributing to future research on tsunami deposits. I found that the eastern part of the Boso Peninsula suffered from the effects of the tsunami for a long time. As sand was transported into the fields not only by changes in the coastline but also by tsunami, this is an example showing that crops could not be planted in the area. Moreover, in this area, as the diastrophism was small, the tsunami is considered to have infiltrated also into the inland plain. I noted that the effects of the tsunami differed in different areas according to the differences in the geometry of the coastline and the different tsunami heights.

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